Original Discovery, Visual Evidence, and Licensing Declaration

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Title: **Dimensional Correction of QFT Vacuum Energy and the Resolution of the Vacuum Catastrophe**

Discovery Abstract and Statement of Origin

This document records the original insight that the long-standing 10^{123} -order discrepancy between quantum field theory (QFT)'s predicted vacuum energy density, and the observed cosmological constant (the 'vacuum catastrophe') arises not from incorrect physical laws, but from a dimensional inconsistency. QFT assumes vacuum energy scales per Planck volume ($\frac{E_P}{\ell_P^3}$), while general relativity (GR), guided by the holographic principle and gravitational thermodynamics, requires energy to scale with surface area and cosmic size ($\frac{E_P}{\ell_P^2} \cdot R$).

This dimensional correction reduces the predicted vacuum energy from approximately $\rho_{\text{QFT}} \approx 4.63 \times 10^{113}\ \text{J/m}^3$ down to approximately $\rho_{\text{obs}} \approx 1.0 \times 10^{-10}\ \text{J/m}^3$, in alignment with observations, without invoking dark energy or fine-tuning. This reframes the cosmological constant as a consequence of geometric structure.

The corrected vacuum energy density is given by:

$$\rho_{\text{vac}} = \frac{E_P}{\ell_P^2 \cdot R}$$

Visual Evidence of Dimensional Resolution:

Figure 1. QFT vs GR Predicted Vacuum Energy Densities - Exposes the 10^{123} discrepancy and its dimensional root.

Aspect	QFT	GR + Thermodynamic Constraint
Domain	Quantum fields	Gravitational curvature
Formula	$\rho_{\text{vac}} \sim \int \frac{1}{2}\hbar\omega(k)\,dk$	$\rho_{\text{vac}} = \frac{\Lambda c^2}{8\pi G}$
Assumption	Energy fills **volume**	Energy curves space via **surface constraint**
Scaling	$\rho \sim \frac{E_P}{\ell_P^3}$	$\rho \sim \frac{E_P}{\ell_P^2 \cdot R}$
Predicted Result	$\sim 10^{113123}\ \text{J/m}^3$	$\sim 10^{-10}\ \text{J/m}^3$ (observed)

Figure 2. Dimensional Correction Comparison - shows GR and corrected QFT alignment via geometric scaling.

Aspect	QFT (Corrected)	GR + Thermodynamic Constraint
Domain	Quantum fields	Gravitational curvature
Formula	$\rho_{\text{vac}} \sim \frac{E_P}{\ell_P^2 \cdot R}$ *(after dropping one spatial dimension)*	$\rho_{\text{vac}} = \frac{\Lambda c^2}{8\pi G}$
Assumption	Energy fills **surface** (area) and scales with cosmic size	Energy curves space via **surface constraint**
Scaling	$\rho \sim \frac{E_P}{\ell_P^2 \cdot R}$	$\rho \sim \frac{E_P}{\ell_P^2 \cdot R}$
Predicted Result	$\sim 10^{-10}\ \text{J/m}^3$	$\sim 10^{-10}\ \text{J/m}^3$ (observed)

Figure 3. Compatibility with Quantum Theory - confirms Casimir effect is reinforced and all QFT observables remain valid.

Quantum Prediction	Domain	Affected?
Lamb shift	Local	❌ No
Casimir effect	Area-based	✅ Reinforced
Standard Model loops	Local & differential	❌ No
Renormalization	Relative, not absolute	❌ No

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Declaration Summary

This document serves as timestamped public disclosure of the original discovery, independently derived by John Morris. It affirms authorship priority, licensing intent, and foundational implications for vacuum energy and unified physical laws.